THE DENTAL PRACTITIONER

AND DENTAL RECORD

Including the official reports of the British Society of Periodontology, the British Society for the Study of Orthodontics, the European Orthodontic Society, the Liverpool and District Odontological Society, the North Staffordshire Society of Dental Surgeons, the Odonto-chirurgical Society of Scotland, and the Dental and Medical Society for the Study of Hypnosis

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THE DENTAL PRACTITIONER
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Vol. VII, No. 2 October, 1956

EDITORIAL

THE BRITISH STANDARDS INSTITUTION

THE annual report of the British Standards Institution* shows the increasing activities and support of the varied work carried out by this institution. Of notable interest and importance to us is the work of the committee on the dental industry and the newly formed committee in the chemical division concerned with dental materials. An extremely important paragraph in this report (page 83) states that ". . . it became evident that drafting of standards (on dental materials) was being held up because experimental data on some materials involved were lacking. At the request of the Dental Industry Standards Committee discussions took place with the Department of Scientific and Industrial Research to find out whether facilities could be made available for combined clinical, physical, and chemical investigations to be undertaken. As a result of these discussions the Ministry of Health has now set up a committee to draw up a programme of research, development, and testing in relation to dental materials, the research services of the Department of Scientific and Industrial Research being made available as required." This is a very important step forward. It is something that many of us have waited for and trust will be the beginning of a plan for large-scale research and investigation into the properties of dental materials. Without knowing all the facts it is difficult to see how standards could possibly be laid down, for incomplete standardization is of little use to anyone. There is undoubtedly a wide gap in our knowledge of the properties of many dental materials, a gap which has at times led to hard words by the profession about some of the materials they use in routine practice. This is of course only a beginning and there is a lot of hard work to be done even before any research is commenced. The problem is, however, urgent and we trust that in the near future we may look forward to further reports on this aspect of the work of the British Standards Institution. We believe that this is a foundation stone for a permanent edifice and its growth will be watched carefully and we trust with approbation by this journal.

* *Annual Report*, 1955–6. British Standards Institution, British Standards House, 2 Park Street, London, W.1. 8½ × 5½ in. Pp. 259. 5s.

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TALKING ABOUT SALIVA*

By **A. C. KERR**, B.Sc., L.D.S. R.F.P.S.
Dental Research Fellow, Department of Dental Medicine, Guy's Hospital, London

THE composition of saliva can be considered under three headings, namely: the secretions of the oral glands, the bacterial content and its products, and lastly, food particles, epithelial cells, and leucocytes. This paper is concerned mainly with the secretions of the glands and to a lesser extent with bacteria.

The functions of saliva fall under two main headings:—

1. Alimentary functions. Saliva makes tasting possible and without it chewing or swallowing would be difficult. The enzyme amylase is believed to play a part in digestion.

2. Protective functions, and for those concerned with dental disease these are extremely important. Saliva provides lubrication, physical cleansing, chemical buffering, and antibacterial activity. Under the heading of lubrication there is a function of which I am particularly conscious just now, that of facilitating talking. The lecturer's glass of water to replace his oral secretions inhibited by anxiety is adequate testimonial to the importance of this function.

Having defined the field of interest the three topics that will be considered in some detail are: variations in the quantity of saliva; variations in the quality of saliva; and, lastly, since it is a matter of direct interest to the periodontologist, reference will be made to salivary calculus. The methods and the results of some experiments will be discussed. Emphasis will be placed on describing the methods used, on the principle that if some defect in the method is overlooked then the experiment done is not the one intended and the conclusions will be misleading.

VARIATIONS IN QUANTITY

Most experiments involving the examination of saliva begin with the premiss that some hypothetical relationship between the oral tissues and the fluid bathing them is worthy of study. Samples of whole saliva have therefore been taken for analysis.

The collection of whole saliva is a simple, though inelegant, procedure and can be done in three ways which can be labelled dribble, spit, and suck. The terms are self-explanatory and are listed in order of the increasing amount of disturbance caused in the subject's mouth.

In order to speed the process of getting enough for analytical purposes the practice of chewing wax was introduced and the saliva so obtained designated "activated" in contrast to what was obtained under "resting" conditions. It is still doubtful whether either resting or activated saliva should be used for analyses (Becks, 1939; Becks and Wainwright, 1939). The division of whole saliva into two distinct types is quite misleading as can be seen in *Table I.*

This table gives some idea of the range of the outputs of whole saliva under different conditions of stimulation in a group of some 80 young people of both sexes. The experimental conditions were relatively well standardized. With subjects sitting quietly in the laboratory a basal flow ranging, between subjects, from 0·02–1·1 ml./min. was collected. If various things were put in the subjects' mouths there was an increase in the outflow of saliva, the amount depending upon the substance.

The ratios of the mean outputs during stimulation to the mean basal output were roughly 10 for the citric acid, 7 for the sodium chloride, 4 for the wax chewing, and 3·5 for the sucrose. Individual values for these ratios were quite variable but the pattern was generally the same, i.e., the citric acid usually stimulated the largest output. The difference between the highest and lowest response to the citric acid was striking, but the coefficient of variation was the same (about 40 per cent) in each test.

* Condensed from a paper presented to a meeting of the British Society of Periodontology at the Eastman Dental Clinic, London, on April 9, 1956.

Why some people's salivary output should be so much greater than others is a mystery. Becks and Wainwright (1943) in a study of 661 individuals were unable to correlate the saliva flow rates with sex or age (above 10 years). An attempt to correlate the variations shown in *Table I* with body-weight was completely unsuccessful.

Such stimulus-response results are closely repeatable provided that sufficient time is allowed to elapse between each test and the it works well and the minor variables can be ignored.

Fractions of Saliva.—Since on a histological basis there are four different types of gland secreting into the oral cavity attempts have been made to study the behaviour of individual glands. To collect individual gland secretions a small chamber is held over the gland opening and the secretion is led out of the mouth through a flexible tube. The central chamber can be replaced by a plastic cannula,

Table I.—The Output of Whole Saliva in Response to Different Types of Stimulation

Stimulation		Time min.	No. of Subjects	Output: ml./min.		
Quality	Strength			mean	S.D.	range of 2 S.D.
Basal		10	82	0·56	0·27	0·02– 1·10
Sucrose	10 per cent soln. 1 ml.	1	69	1·93	0·84	0·25– 3·61
Wax chewing	2 g., m.pt. 50° C.	5	82	2·34	1·00	0·34– 4·34
Sodium chloride	20 per cent soln. 1 ml.	1	69	3·82	1·33	1·16– 6·48
Citric acid	4 per cent soln. 1 ml.	1	69	5·49	2·33	0·83–10·15

S.D., Standard deviation. Range of 2 S.D. gives the limits which bounded 95 per cent of the observations.

experimental conditions are adequately standardized. If this is not done, considerable variations occur (Wainwright, 1939).

To illustrate the point, if one goes on collecting the basal output its rate gradually increases, probably because the mouth becomes dry and drying of the mucosa promotes secretion. Moistening of the mouth decreases the flow again. The investigation of the lower limit of saliva production is thus hindered by the difficulty of preventing stimulation arising from the collecting technique. The upper limit is also difficult to study because of the fact that strong stimulation if carried too far becomes injurious and the receptor part of the reflex is knocked out (Lashley, 1916).

Consideration of these salivary reflex phenomena thus brings me to my first generalization, which is that under physiological conditions the amount of saliva that can be collected from a mouth depends on the amount of stimulation which is applied to the mouth. There are a great many qualifying phrases which could be added to that statement to improve its accuracy but for practical purposes

held in position by a coaxial suction chamber. Lashley (1916) pioneered the study of the human parotid glands and Schneyer and his colleagues have recently made valuable contributions to the study of the submaxillary and sublingual glands using a device which looks like the lingual flange of a lower denture extended to fit over the plica sublingualis (Schneyer, 1955). The output of the small discrete glands defies collection except as what is left over, but Östlund (1953) made an ingenious assessment of the output of the palatine glands. He examined the size of the pits in an alginate impression held over the gland openings, these pits being caused by mucus expelled from the glands. He concluded that the palatine glands secreted at a slow steady rate. Measurement of secretion rates is usually made by collecting secretion in calibrated vessels for measured periods, but a recording flow-meter gives information on short-term fluctuations much more conveniently.

With this arrangement of cannula and flow-meter the response of the parotid gland

to various stimuli has been studied in this laboratory.

Activity of the Parotid Gland during Mastication.—A typical record showed that when the subject was given a piece of wax and asked to chew it on one side only the secretion rate on that side was markedly increased while the flow on the other side was only slightly raised. If he was invited to chew as he pleased he periodically moved the bolus from one side to the other, the resulting total secretion rate being greater than during unilateral chewing. This relative inactivity of the gland on the non-stimulated side is an observation as old as 1854 (Colin, 1854) but it has been generally ignored. Its importance in dentistry is obvious. A patient who limits, for one reason or another, his chewing to one side will lose most of the cleansing and protective function of the parotid secretion on the other side. The chewing of hard wax melting at 56° C. provoked about 50 per cent more secretion than the chewing of soft wax melting at 39° C. Empty chewing movements produced no increase in parotid secretion rate but when pieces of wax of various weights were chewed the rate of output of secretion rose exponentially with the weight of the wax bolus. It can be concluded from these experiments that the amount of secretion from the parotids provoked by wax chewing depends on the way in which chewing is distributed between the two sides of the mouth, on the resistance of the wax to the closure of the teeth, and, most important, upon the size of the piece of wax chewed.

Fractional Secretion Rates.—The data presented refer only to the parotid gland. Other experiments involving the simultaneous collection of the non-parotid secretions by suction showed that the non-parotid fraction of saliva behaved in a similar way with regard to wax chewing.

Schneyer and his colleagues have found that under true basal conditions the parotids produced no secretion and the submaxillary and sublingual glands infinitesimally small amounts (Schneyer, Pigman, Hanahan, and Gilmore, 1956). Under resting conditions the submaxillary contributed about 70 per cent, the parotid 25 per cent, and the sublingual 5 per cent of the fraction total (Schneyer and Levin, 1955 a). With moderate chemical stimulation the parotid contribution rose to 34 per cent, the submaxillary dropped to 63 per cent, and the sublingual to 3 per cent (Schneyer and Levin, 1955 b). During wax chewing I have found that the parotid share as compared with the non-parotid fraction could rise to about 50 per cent of the fraction total under conditions of strong stimulation.

VARIATIONS IN QUALITY OF WHOLE SALIVA

Since the compositions of the saliva fractions are markedly different the composition of whole saliva will depend upon the size of each of the different fractions. For example the respective viscosities of parotid, submaxillary, and sublingual secretions are 1·5, 3·4, and 13·4 centipoises (Schneyer, 1955). The viscosity of whole saliva will obviously depend upon the balance between the secretion rates of the parotid with its low viscosity secretion and the other two glands with their high viscosity secretions.

Variations in Quality of a Glandular Secretion.—Having drawn attention to differences between saliva fractions, I now intend to consider briefly the behaviour of an individual gland secretion. Remarks will be confined to the inorganic constituents of parotid secretion. These reach the secretion either by permeation through both membranes of the gland and duct cells or as a result of some metabolic activity within the cells. It is clear that some change must take place in the cell membranes during stimulation to allow for the passage of the large volumes of water, and it would be surprising if the substances in solution were in the same concentration at different rates of secretion. In fact at maximal secretion rates the total ionic concentration is about double that at minimal secretion rates (Yoshimura, Takaoka, and Mori, 1954). The concentration of protein also rises (Langstroth, McRae, and Stavraky, 1938). Hildes and Ferguson (1955) studied the variations of some individual ions in saliva. They repeated in man some of the studies of secretory processes in animal salivary glands carried out by Babkin

(1944) and his associates. They found that the sodium and chloride concentrations of parotid secretion rose with increasing flow rates to values approaching the plasma concentrations of these ions. Potassium remained constant at approximately six times the plasma concentration and phosphate declined slightly to

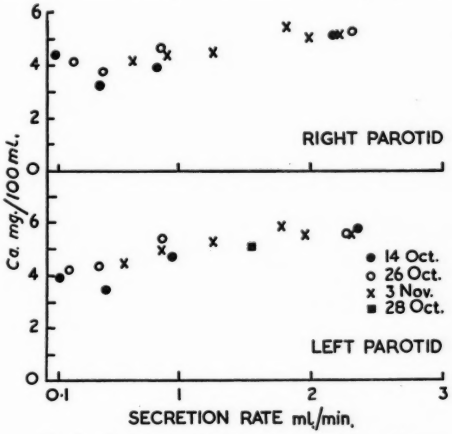

Fig. 1.—Effect of secretion rate on the calcium concentration of the parotid gland secretion. The samples were obtained from one subject on four different days, using four different methods of stimulation.

begin with, then reached at maximal flow rates a value roughly three times that of the plasma concentration. The parotid secretion bicarbonate concentration reached the plasma bicarbonate concentration at a flow rate of approximately 1 ml./min. and thereafter exceeded it, suggesting that bicarbonate was manufactured in the gland. The *p*H was equivalent to the plasma *p*H at about 1 ml./min., and at higher rates rose probably because of the increased bicarbonate concentration.

One ion which they did not study was calcium. The effect of the rate of flow on the calcium concentration of the right and left parotid secretions of one subject is shown in *Fig.* 1. It can be seen that the calcium concentration was positively correlated with the rate of output of secretion. At maximal flow rates the calcium concentration was approximately the same as that of the plasma diffusible calcium in the normal subject. If the values were all the result of a unified process they could hardly be expected to be a better fit for a regression line, yet in fact the samples of secretion were provoked by four different stimuli—wax, acid drops, barley-sugar, and spearmint chewing-gum—and they were collected from the subject on four different days.

On the basis of this kind of evidence it is possible to formulate a hypothesis, first suggested by Langstroth, McRae, and Stavraky (1938) that under physiological conditions the composition of parotid gland secretion is a function of the rate at which it is produced. It is possible to go further and suggest that the composition of a glandular secretion depends primarily upon the quantity of stimulation applied reflexly to the gland. This is put forward rather in the nature of a protest against the old and complicated hypothesis that the quality of the stimulus determines the composition of the salivary secretion.

These findings seem to indicate that if saliva is to be analysed for some purpose or other it is extremely important that the methods by which the samples are obtained should be carefully standardized and recorded. If this is done there are no reasons why salivary analyses should not provide reasonably repeatable and reliable indices for biochemical studies.

SALIVARY CALCULUS

To investigate the nature of calculus there are five main approaches; clinical, histological, chemical, physical, and microbiological.

In illustrating the clinical approach I am indebted to a member of your Society, Mr. Day, for referring to me the girl whose mouth is shown in *Fig.* 2. She was nine years old, suffered from hereditary enamel hypocalcification, and complained of a generally sore mouth. The surface of the teeth was very rough owing to the loss of enamel and a deposit of calculus appeared to be doing its best to replace the missing tissue. Her saliva production was quite normal—about 1½ ml./min. while chewing wax. Turning to the histological approach, *Fig.* 3 shows a decalcified section of part of the crown of $\overline{D}$|. The

most noticeable feature is the luxuriant plaque covering the remnant of well-preserved enamel matrix. Of the two zones in the plaque the outer darker one appeared under very high magnification to be formed of closely packed threadlike organisms. In the inner, paler zone there were fewer thread-like organisms and

Fig. 2.—Extensive calculus deposition on the teeth of a child of 9 years with enamel hypocalcification.

cocci were the predominant forms. Amongst the organisms there was much amorphous material which was probably mucin. The paler zone had probably been calcified and the darker zone may have been destined to become calcified.

From clinical and histological studies two salient features emerge—namely, that rough surfaces and backwaters predispose to calculus formation, and that the calculus matrix is composed predominantly of the bodies of micro-organisms. Studies in germ-free animals should soon present us with the definitive answer to the question whether micro-organisms are essential for calculus formation. At present there are very few who would contest the view that they are essential.

Chemical investigations, of which that of Glock and Murray (1938) is probably the most important, gave us information about the number of atoms of various types present in a sample of calculus. Inorganic ions amounted to about 82 per cent and were chiefly calcium and phosphorus with small amounts of magnesium and carbon dioxide also present. From percentage compositions the chemists estimated the molecular structures present. These were, in round figures, $Ca_3(PO_4)_2$ 76 per cent, $Mg_3(PO_4)_2$ 4 per cent, $CaCO_3$ 3 per cent, protein 8 per cent, water 6 per cent, and fat 3 per cent. At that time, however, they were without information on the arrangement of the ions in space. The architecture of the crystal lattice is the prime factor controlling

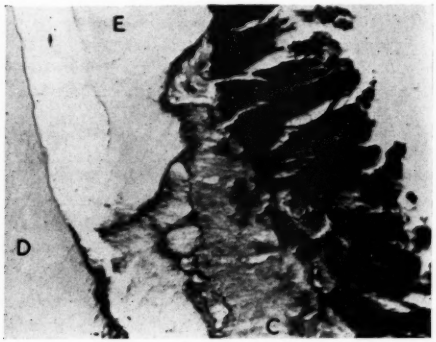

Fig. 3.—Part of decalcified section of $\overline{D}|$ from the case shown in *Fig.* 2. E, Hypocalcified enamel matrix. D, Dentine. C, Calculus matrix covered with heavily stained plaque. Gram stain. (× 120.)

the physical properties of a solid. Diamond and graphite for example have the same atomic composition, but the arrangement of the atoms in the lattice is quite different, so that the one makes a cutting tool and the other a lubricant.

The physical tool of greatest use in the examination of the structure of calculus is the X-ray beam. By radiographing a sample of calculus, preferably using a stereoscopic technique, it can be seen that the density varies in different regions of the calculus. Laminations are often present which could be due to growth being intermittent rather than continuous (*Fig.* 4). Another cause of density variations is the inclusion of food particles. If sections of equal thickness are compared it can be seen that calculus is of the same order of density as enamel and is more dense than dentine.

The most useful application of X rays is to the identification of crystal structure by means of diffraction patterns. When an X-ray beam is directed through a specimen of a crystalline powder the rays are scattered in a way which

is characteristic for the crystal under examination. If the powder is mounted on a glass spike surrounded at a little distance by a narrow cylindrical strip of film sensitive to X rays and the beam enters at right angles to the axis of the cylinder a complex pattern of lines of varying widths and intensity is produced.

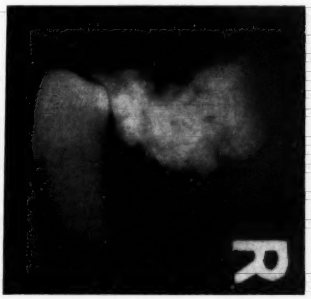

Fig. 4.—Radiograph of a large salivary calculus attached to $\overline{1}$. Laminations, possibly due to intermittent growth, are visible in the calculus.

Each pattern is diagnostic of the lattice structure or structures present in the powder. Calculus has been examined by this method by several groups of workers, notably King, Rowles, Little, and Thewlis (1955). They found that the minerals in human calculus were nearly always in the form of hydroxyapatite. Jensen and Danø (1954), on the other hand, found that as well as hydroxyapatite there were appreciable quantities of whitlockite (β-tricalcium phosphate) and small amounts of brushite present. They suggested that some salivary factor was inhibiting hydroxyapatite precipitation. This disagreement is very interesting because elucidation of the puzzle might well give a clue to the mechanism of calculus formation.

It is my guess, and it is no more than a guess, that in calculus precipitation we are dealing with a process of living calcification. I do not think that a general chemical explanation in terms of supersaturation, critical *p*H, CO_2 loss, and so on is enough to account for its formation in certain particular places, but feel rather that the process arises through the metabolic activity of the micro-organisms present in the plaque producing micro-environments favourable to the assembly of the calcium, phosphate, hydroxyl, and carbonate ions in a lattice structure.

SUMMARY

Aspects of human salivary gland function are reviewed with special reference to variations of the quantity and quality of saliva. The nature of salivary calculus is briefly considered.

Acknowledgements.—I would like to express my gratitude to Dr. K. Little for generous assistance and the loan of illustrative material for this talk; to Dr. A. Rose for estimating the calcium concentrations; to Mr. J. E. Hutchinson for preparing sections and photomicrographs; and to the departments of Dental Photography and Medical Illustration, Guy's Hospital, for their excellent services.

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DISCUSSION

Dr. R. L. Hartles, in opening the discussion, congratulated Mr. Kerr on his most interesting paper and commented as follows: The use of more exact techniques for the study of salivary secretion is to be welcomed. This approach is likely to yield information which may enable the causes of individual variation in saliva

secretion to be determined. Mr. Kerr is to be complimented on devising a technique which can measure salivary flow with an exactness not hitherto obtainable.

The suggestion concerning "living calcification" is an interesting one. It is undoubtedly true that wherever and whenever calcium and phosphate are deposited in a biological medium an apatite-like composition is achieved. Whether or not the micro-organisms in the mouth govern the actual process is still, in the present state of knowledge, a matter for debate. If the *p*H is near to neutrality and precipitation of calculus is initiated in a medium containing the necessary ions, then a form of apatite will be formed. In other words, it is the physicochemical environment which will decide whether or not calculus is formed. Micro-organisms may influence the deposition of calculus in so far as they may cause variation in the environment.

Nevertheless, no sample of calculus has yet been observed which is free from micro-organisms and the relationship between the two is a problem which needs to be investigated fully.

SOME OBSERVATIONS ON THUMB-SUCKING

By **ILJA FRISCHMANN**, L.D.S. R.C.S. (Eng.)

A DENTIST is often asked for advice on the malposition of teeth caused by persistent thumb-sucking, and it is expected of him to deal with these cases. Before any course of treatment can be commenced some basic considerations are necessary to form a clear conception of the problems involved.

The literature on this subject can be roughly divided into two parts: one, from the psychiatrist's point of view, dealing with the causation and background of this habit; the other, from the dental aspect, which mainly describes the ensuing malformation in the mouth and the application of appliances to correct it. From this it would appear to follow that the treatment should be performed in close co-operation between psychiatrist and dentist, but this is not necessary in most cases. In practice, the dentist alone can deal with this condition with a large degree of success.

It can be said from general observations that thumb-sucking in the young infant is quite usual, and it comes rather as a surprise if it does not take place. But as the development of the child proceeds he is expected to outgrow this habit, and consequently to drop it at a certain stage. It cannot be said with certainty at what age this should happen, but it is a fair indication that most children have outgrown the tendency by the time they start school.

As far as these considerations are concerned the practitioner has to deal with those cases in which the thumb-sucking continues, taking into account two causes for it:

1. That the development of the child has been delayed in this particular line;

2. That some outer influence is acting on the child, making him seek relief in the comfort of thumb-sucking. This clearly excludes any maladjusted children.

Looking at it from this angle brings to mind the adverse result any compulsion in the treatment might have on the patient. Many devices have been designed in the past with the aim of breaking the habit and the child was forced to wear one of these. The idea of this treatment was to suppress the thumb-sucking without any concern for the underlying cause. The real effect must have been that the already existing difficulties of the child were increased. Under the circumstances, if the patient was sufficiently strong-willed he could overcome all threats and appliances and eventually continue happily in his habit. On the other hand, if he was of a more yielding nature he might give up the thumb-sucking, and as an outlet acquire a different habit, with possibly much worse results. Of course, many variations between these two extremes are possible.

In whichever way a case may have been treated, if it is followed by a new habit like nail-biting, etc., it would have to be classified as a failure.

Often when a child comes for consultation a talk with the dentist is all that is necessary

to make him drop this immediately and permanently. The writer would like to compare this condition with a milk-tooth which has been hanging on by a small thread for some time after it was due to be shed. A very slight pull is enough to remove it. Similarly, the child was on the point of outgrowing the habit and it needed only a very small influence to make him drop it entirely. It was fortunate for the patient and dentist that they met at the right time.

But quick results should not be expected and the treatment should never be rushed. On the contrary, it might prove beneficial to observe the child before coming to a decision. This will allow time to find out if any environmental factors have caused the child to seek relief in thumb-sucking, an unlimited variety of which are feasible. In this connexion it is essential for the mother to be present in the surgery when the child attends for treatment and to watch her reactions. This gives some indication of the mother/child relationship and, furthermore, it can help to enlist the mother's sensible co-operation, which might be required in specified ways and so be of very great importance.

Under no circumstances should it be permitted to coerce or ridicule the child. The attitude to be adopted should be to help and to guide without the show of any benevolence. During all this time the dentist has to keep an open mind, for environmental causes often quite suddenly and unexpectedly come to the surface. When this opportunity arises he must be ready to take full advantage of it immediately.

All these measures pave the way to the fitting of an appliance which is designed to suit individual requirements. It has to be realized that the appliance is only one part in the complex treatment of the condition and should only be fitted when the complete co-operation of the patient is secured. It is explained to the child that the plate is provided to help him in his efforts to stop thumb-sucking. The patient is encouraged not to worry about the whole treatment and it is pointed out to him that the appliance is only inserted to act as a reminder in case the thumb slips into the mouth inadvertently.

It is difficult to state which age would be suited best for this treatment as so much depends on the mental development of the child and his whole make-up, to which have to be added all the other factors governing this condition. It is obvious that great opportunities exist in this field for the practitioner who sees his child patients regularly from an early age and keeps watch on their development.

Many children are presented to the dentist at a comparatively late age for correction of the malocclusion caused by thumb-sucking. Fortunately, these cases offer a good chance of success. A child between 9–11 years is usually interested in group activities, like camping, etc., and does not cherish the thought of being watched by his contemporaries sucking his thumb. So his good co-operation is easily secured. The mother, too, having by that time usually exhausted all the remedies known to her, will be very grateful that an entirely new approach is being made, and so be most willing to give any assistance required.

But a note of warning has to be sounded as well. It is an established fact that many children start nail-biting about the age of 10–11, and they may soon slip into this if the effort to stop thumb-sucking proves too much for them. It is for this reason that the treatment should never be pushed.

Concluding, it can be said that the treatment of this habit, with all the inherent difficulties, is well worth every effort. As much as a baby can be admired with the thumb in his mouth, persistent thumb-sucking is, to anybody addicted to it, a great embarrassment and a source of constant irritation to the members of his family. It is a great reward indeed to see the relief in all persons concerned once this habit has been successfully dealt with.

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REATTACHMENT FOLLOWING CURETTAGE

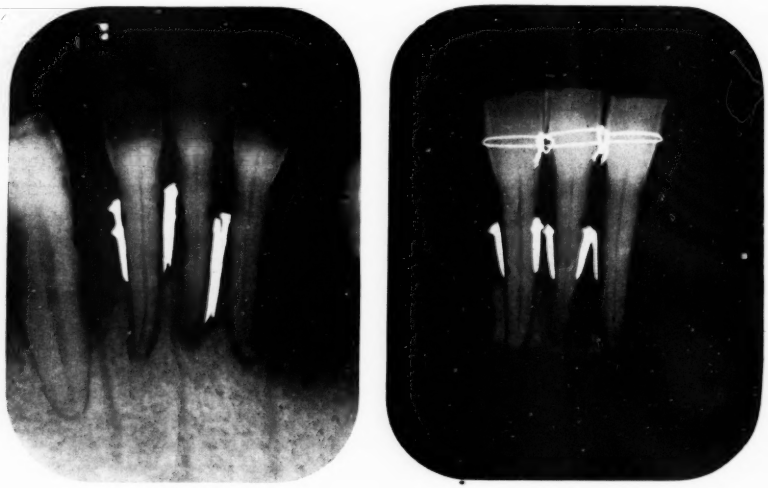
A HISTOLOGICAL STUDY*

By **W. G. CROSS**, M.B., M.S., B.D.S.

Senior Lecturer and Head of Department of Periodontology, Institute of Dental Surgery, Eastman Dental Hospital, London

THE number of cases to be found in the literature demonstrating reattachment in human beings by means of histological sections remains few. For a considerable number of years some periodontists have maintained that as a result of thorough curettage, an organic attachment to the root surface is possible. (Nuckolls, Dienstein, Bell, and Rule, 1950; Goldman, 1948; McCall, 1926; Schaffer and Zander, 1953; Cross, 1954, 1955.) Others, on the contrary, have maintained that such reattachment is impossible, or, if not impossible, virtually so and at least impracticable (Black, 1937; Orban, 1948, Coolidge, 1938; Fish, 1946, 1952.)

For obvious reasons, histological material from treated cases is seldom available, and the present communication is presented, therefore, in an attempt to add to the previously published evidence for reattachment (Schaffer and Zander, 1953).



A B

Fig. 1.—A, After initial curettage. Hirschfeld silver points in position. B, At extraction; note reduction in pocket depths.

CASE REPORT

The patient, a male, aged 52, was referred for scaling prior to extraction of $\overline{21|1}$. These teeth exhibited gross mobility and pockets could not be measured accurately initially owing to large masses of subgingival calculus. The diagnosis was chronic periodontitis.

OPERATIVE TECHNIQUE.—After thorough preliminary curettage to remove deposits, but not pocket epithelium, the interproximal pockets were measured, burr grooves cut at the level of the gum margin interdentally, Hirschfeld silver points inserted, and radiographs taken (*Fig.* 1). From these radiographs it will be seen that pockets were present as follows: $\overline{2}|$ mesial 6 mm., distal 6 mm.; $\overline{1}|$ distal 6 mm., mesial 8 mm.; and $|\overline{1}$ mesial 8 mm. Two silver points have become somewhat misplaced.

After five weeks the root surfaces were again thoroughly curetted, using Coromant tungsten carbide hoes and

* This case was demonstrated at the Clinical Meeting of the British Society of Periodontology, held on May 4, 1956, at the Eastman Dental Hospital, London.

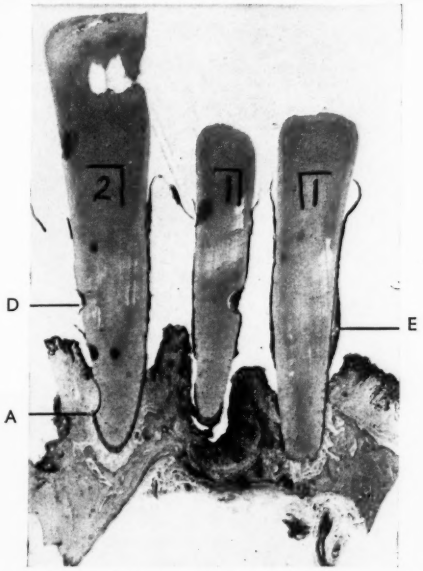


Fig. 2.—Section through $\overline{2|11}$ (low power). A, Lowest level of curettage; E, Calculus; D, Burr marks (at gum margin originally). Owing to plane of section, $\overline{1|}$ gives false impression of being completely detached. (×4.)

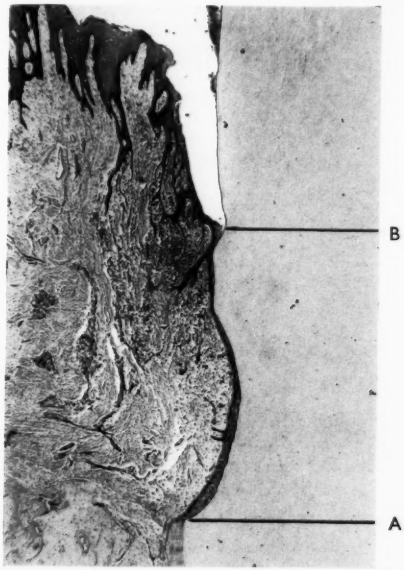


Fig. 3.—Higher power, $\overline{2|}$ distal. A, Lowest level of curettage; B, Base of clinical pocket. A–B, 2 mm. No cementum remains. (×28.)

Fig. 4.—Same section as *Fig.* 3, high power. (×168.)

Fig. 5.—Adjacent section of $\overline{2|}$ distal, very high power, showing epithelial tear; some cells attached to dentine. (×1800.)

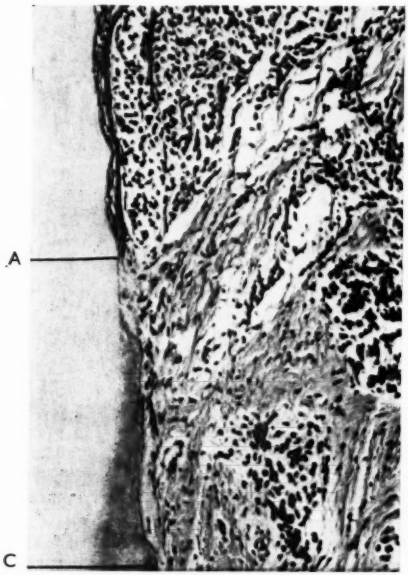


Fig. 6.—$\overline{2}|$ mesial, high power. A, Lowest point reached by epithelium; C, Lowest level of curettage. (×168.)

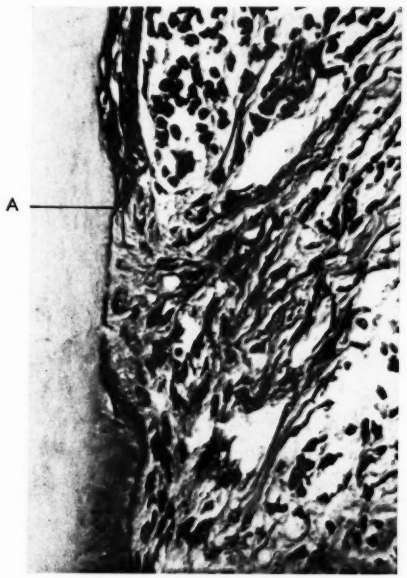


Fig. 7.—Same section, higher power. Note cementoblasts and layer of new cementum formed on dentine. A, Lowest point reached by epithelium. (×350.)

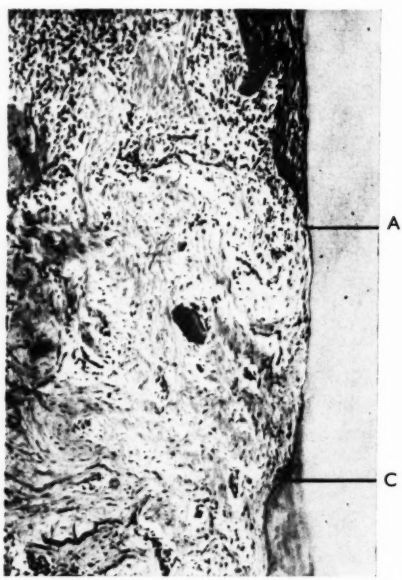


Fig. 8.—$\overline{1}$ mesial, high power. A, Lowest point reached by epithelium; C, Lowest level of curettage. Note fragment of detached cementum. (×100.)

McCall curettes. The teeth were splinted by means of stainless-steel wire ligatures and self-curing acrylic resin.

Four and a half months later the patient was re-examined, and the pocket depths were now found to be: $\overline{2}|$ distal 4 mm., mesial 4 mm.; $\overline{1}|$ distal 4 mm., mesial 4 mm. (*Fig.* 1). These three teeth, together with some interdental alveolar bone, were extracted under local analgesia and a further radiograph taken (*Fig.* 1).

HISTOLOGICAL APPEARANCES.—$\overline{1}$ (distal) was used as a control, no curettage being carried out. Calculus can be seen along the intact root surface (*Fig.* 2).

It seems probable to the author that Waerhaug's view concerning the epithelial cuff is, as far as enamel is concerned, correct, and is therefore accepted by him; it is felt, however, that a rather firm degree of epithelial attachment may take place to the root surface—either to cementum or dentine. In this paper, therefore, re-attachment will be considered as epithelial, connective-tissue, or combined.

Connective-tissue reattachment is considered to have taken place in $\overline{2}|$ mesially, $\overline{1}|$ mesially (1·5 mm.). Epithelial reattachment is considered to have occurred in $\overline{2}|$ distally (2 mm.). This latter is shown in *Figs.* 3–5. These are all from the same section, except *Fig.* 5, which is from an adjacent one. This figure shows a very high-power view of the commencement of attachment, demonstrating a tear in some of the epithelial cells, whilst others remain firmly attached to the dentine. In *Figs.* 6–8 connective-tissue reattachment is seen. In the high-power view (*Fig.* 7), cementoblasts may be seen with a layer of new cementum (cementoid) between them and the dentine. In one section (*Fig.* 8) a detached fragment of cementum may be seen lying in the periodontal membrane.

Conclusions.—Definite reattachment is considered to have taken place in several areas in an unfavourable case. The case is considered unfavourable because (*a*) the pockets were moderately deep yet *supra*bony, (*b*) marked mobility was present even after splinting, (*c*) owing to the teeth being doomed and the patient realizing this, no antibiotics were used during curettage, or special post-operative care taken by the patient. In these circumstances, extensive reattachment was hardly to be expected; that it occurred at all suggests that in the more favourable case much better results may be expected, and in the author's experience this is borne out clinically.

SUMMARY

Three lower incisors were extracted four and a half months after curettage and sectioned. The sections show some degree of epithelial and connective-tissue reattachment.

Acknowledgements.—The author wishes to express his appreciation to the Departments of Pathology and Photography, Institute of Dental Surgery, for the preparation of sections and the print from the radiographs, respectively. He also wishes to thank very sincerely Mr. E. Fanibunda, Department of Pathology, for the photomicrographs, including those originally demonstrated in colour.

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Individual Fluoridation

1. Many children in this area, where the amount of fluorine in the water is very low (it is said to be incapable of measurement), suffer from premature dental decay. Is there any preparation of fluoride which would be suitable for giving to these young children? If so, how should it be administered and in what dosage?

2. In view of the hazards of overdosage, what clinical or laboratory supervision is advised in order to detect this early?

3. Are there any clinical conditions in which fluoride therapy is contra-indicated?

The following answer is given to the above questions:—

1. Sodium fluoride may be administered either in tablet form or by means of a topical application. The tablet dosage is: Up to 2 years old, 0·5 mg. daily; from 2 to 10 years, 1 mg. daily. This dosage is approximately equal to the daily intake of fluoride from public water supply containing 1 part per million. It is suggested that the tablets should be dissolved in water and not swallowed whole, so that the fluoride ions may, if possible, have a local effect on the surfaces of the erupted teeth as well as the systemic effect on those not yet erupted. For topical application a 2 per cent solution of sodium fluoride is used, and this may be applied by dentists.

2. Where the fluoride content in the public water supply is negligible and tablets of sodium fluoride are being dispensed, it is necessary that parents should follow instructions regarding the number of tablets to be given. Further, it is desirable that a parent should not be given a large supply of tablets at one time. By this means a reasonable control of the case can be kept. In areas where the fluoride content of the public water supply exceeds 1 p.p.m. the enamel shows a tendency to become mottled. The extent of mottling increases as the fluoride content of the water rises, and if this should reach 6 p.p.m. the whole surface of the teeth may be affected. Presumably a chronic overdose of sodium fluoride by ingestion would produce a similar result.

3. According to present-day knowledge there is no clinical condition in which fluoride therapy is contra-indicated. If there were, the fluoridation of public water supplies would not be justified.—*Brit. med. J.*, 1956, **1**, 1312.

ASPECTS OF THE TRANSITION FROM DECIDUOUS TO PERMANENT DENTITION*

By **EILEEN M. E. BONNAR**, L.D.S., D.D.O.
Department of Orthodontics, Royal Victoria Hospital, Belfast

I. BUCCAL SEGMENT OCCLUSAL CHANGES

THIS paper deals with the occlusal changes affecting buccal segment relationships which take place prior to and during the change-over from deciduous to permanent incisors. Other aspects of the change-over will be dealt with in a second paper.

The study of which this paper is a partial account was commenced in 1949 because there were problems in connexion with the relationship of permanent incisors on which the literature of orthodontics gave no satisfactory light.

The incisor group of permanent teeth has a significance for the orthodontist which marks it off from any other group in the dentition. The limits of space within which its members can arrange themselves are determined by the deciduous canines, which are not due for replacement until long after the establishment of the permanent incisors. Since the latter are always larger than the deciduous incisors, this makes them dependent for regular alinement on growth, and the timing of growth, to an extent which does not apply to any other teeth, except possibly the third molars. The space required, for instance, for the regular alinement of 3, 4, and 5, is always less than that occupied by c, d, e, their predecessors. Furthermore, the incisors always go through a stage of crowding before eruption, owing to their crowns achieving full size at an early stage of jaw growth. From the point of view of the practice of orthodontics, problems arise from the fact that malocclusions are most commonly seen when the full upper-lower incisor relationship has been established. The closeness of that relationship frequently creates an impression that it is due to the interaction of the two groups, but it is not established that this is the case. There is the alternative possibility that the malpositions which lead to the malocclusions of the teeth are established, wholly, or in part, before eruption.

It was decided, therefore, to study by means of serial recordings the period of development of the dentition during which replacement of deciduous incisors by permanent takes place. The study, however, was planned not as a test of any particular hypothesis, but as a systematic recording of all events in the dentition during the chosen period. Review of the literature made it seem unlikely that anything new would emerge relating to fields other than that of the incisor relationship, but in fact it was found that so much did emerge that it has been necessary to limit the account in this paper to the changes in the molar region.

THE LITERATURE

Delabarre (1819) described for the first time the spacing of the anterior deciduous teeth between 4 and 6 years, and suggested that the purpose was to make allowance for the permanent teeth. This concept still prevails among most writers of present-day text-books, e.g., Dewey Anderson, Korkhaus, McCoy, Salzmann, and Strang.

Kantorowicz (1926) was the first to emphasize the necessity for a genetic approach to the classification of dentofacial and occlusal anomalies on the basis of a large number of serial models of development.

Schwarz (1931) reported an anatomical study of the problem. He accounted for occlusal adjustment by means of tooth morphology.

Fricl (1926) published his classical work *Occlusion, Observations on its Development from Infancy to Old Age*, and in 1954 *The Development of Ideal Occlusion of the Gum Pads and the Teeth*. His theory of the development of ideal occlusion has been widely accepted and

* A paper read before the British Society for the Study of Orthodontics at the meeting held on March 12, 1956.

taught, though questioned by many orthodontists. The changes which he found taking place after the complete eruption of the deciduous teeth and before the complete eruption of the permanent teeth were:—

"1. Slight forward growth of the anterior portion of the mandibular deciduous arch, but mainly lateral growth of the whole arch to accommodate the mandibular permanent incisors.

"2. Slight forward growth of the anterior portion of the maxillary deciduous arch, but mainly lateral growth of whole arch to accommodate the maxillary permanent incisors.

"3. Forward growth of whole mandibular arch to compensate for greater increase in size of maxillary arch.

"4. Labial inclination of permanent incisors, especially the maxillary incisors.

"5. Forward movement of maxillary and mandibular first permanent molars after the loss of the second deciduous molars."

His diagram showing the five stages of ideal occlusion from 3 years of age show that at 3 years the distal surfaces of the second deciduous molars are in the same vertical plane. Between 3 and 6 years the mandibular arch has moved forward in relation to the maxillary arch, so that when the first permanent molars erupt, the point of the medio-buccal cusp of the maxillary molar comes into occlusion slightly mesial to the buccal groove of the mandibular first permanent molar. Later when the premolars replace the deciduous molars, the lower first permanent molar again moves forward into the extra space provided by the greater discrepancy between $\overline{543}$ and $\overline{edc}$, than between $\underline{543}$ and $\underline{edc}$ so that now the tip of the medio-buccal cusp of the upper tooth is opposite to the buccal groove of the lower. From then onwards, with cuspal wear, there is further forward movement of the lower arch, till the incisors may meet edge to edge.

Friel based his hypothesis on observation of cases of all ages over a long period and a detailed study of 214 chimpanzee skulls of different ages.

Lewis and Lehmann (1926) report the results of four-and-a-half years' observations of the width changes of the deciduous arches. Impressions were taken yearly for a number of children from the age of $2\frac{1}{2}$ years.

They found that "the functional points of the permanent series, as described by Hellman, hold for the deciduous series with only a few slight variations. Not one case out of 106 agreed *in toto* with the ideal scheme as advanced by Friel. Variation is the rule in occlusion of the deciduous series. In some cases there was a decrease in the overbite, especially noticeable at the time of eruption of the first permanent molars, except where there was a Class II, division 1 tendency. The deep overbite in those cases did not change. In general, as the incisors and canines showed attrition, a change occurred in the overbite relation. This change is due more to a forward growth, or drifting of the mandible, and sometimes of the teeth themselves, than to growth in a vertical direction. The occlusion at 5 was the same as at 3. The greatest change in occlusion seems to occur immediately before or immediately after the eruption of the first permanent molars and affects the overbite in the anterior region. The greatest increase in width of the arches occurs after the age of 6 years and is in the upper canine region. Measurements of the deciduous teeth offer no solution in diagnosing malocclusion. To predict the outcome of the permanent dentition from the deciduous is hazardous."

In 1932 Lewis and Lehmann published "A Quantitative Study of the Relation between Certain Factors in the Development of the Dental Arch and the Occlusion of the Teeth". The material comprises a series of models of 75 children taken once yearly for 8 years.

At the beginning the full complement of the deciduous teeth is present, and in the last all the permanent teeth except the third molars.

"We were interested, first of all, in determining whether or not there was a positive correlation between the combined diameters of the deciduous incisors and those of the succeeding permanent incisors. Could the size of the permanent incisors be predicted with any degree of accuracy from that of the deciduous incisors? (Northcroft stated that there is a direct relation between the two

sizes.) Though we found a fairly high correlation between the combined diameters of the deciduous and of the permanent incisors, the findings showed that the variability was great and the measurements of the 'deciduous' incisors are of little value as an index of the size of the permanent incisors. We found that the alinement of the permanent incisors cannot be predicted from that of the deciduous incisors. Also that spacing and alinement appear to bear little relation to one another, though there are more good alinements in the 'wide spacing' group. It is evident that other growth factors than wide spacing are of the utmost importance in determining the alinement of the permanent incisors. Bogue's method of using certain palate measurements as an index of developing malocclusion we found to be unsound. The diameter of the deciduous incisors appears to bear some relation to their spacing, the smaller the diameter, the greater the spacing (also confirmed by Lundstrom). The alinement of the permanent teeth cannot be forecast accurately on the basis of the relation between intercanine growth and the difference in diameter between deciduous and permanent incisors. The incidence of malocclusion increases as the dentition passes to the mixed stage. Sometimes it changes to normal and one type may change to another type.

They stress the need for further observations over a period of time—more and more investigations along similar lines and more observational methods.

Frederick Neumann (1931) in Bonn had a series of 44 cases. Their results differed somewhat from those of Lewis. They seemed to be interested mainly in the spacing of the deciduous teeth and the correlation between this spacing and positions of the permanent incisors.

He concluded: "that developmental spaces only occurred where there was a large difference between the widths of the deciduous and the permanent incisors. When spaces were missing it often happened that the permanent incisors came into their normal positions. The size of the frontal growth of the jaw depended upon the need for space, i.e., differences in the total width of deciduous and permanent incisors. These widths were related to each other. When the difference in widths was large, the natural growth in width and length of the jaws began earlier and gave rise to spacing between the deciduous incisors. A physiologic spacing of the deciduous incisors, therefore, meant a large difference in the width of the deciduous and permanent incisors."

Clinch and Sillman were the first to present developmental series of dentitions from birth.

Clinch (1940) showed serial models of two cases between birth and four years. In one case she found that "at birth the lower gum pad is very slightly lingual to the upper. The first models at $1\frac{1}{2}$ years show an increased incisal overbite, at $2\frac{3}{4}$ years there was a slight reduction in the overbite, and at 4 years a considerable reduction. Occlusal views show that the lower arch has moved forward in relation to the upper arch. There was no increase of arch breadth or change in arch length."

In the other case "The lower gum pad is well behind the upper at birth, but there is a vertical space in the incisor region. At $3\frac{1}{2}$ years there is normal occlusion of the deciduous molars." She attached great importance to the vertical space between the gum pads in the incisor region at birth. "The lack of space was a bar to further development of the mandible and the occlusion could not be normal at a later date. The changing arch relationship between birth and four years is also clearly shown."

In 1951 Clinch also published an analysis of serial models of children between 3 and 8 years. Models were taken of approximately 61 children at yearly intervals. This report deals principally with different measurements of the arches at the various stages of growth.

It was found that "the main increases in intercanine width take place during the time of eruption of the permanent incisors, and only slight increases were recorded over the rest of the period. Changes in the occlusion followed the description given by Friel—the lower deciduous molars move forward in relation to the uppers. These changes take place without a reduction in the size of spaces. (The largest space was 1·7 mm. whereas the

lower molar may move forward 4·5 mm. in relation to the upper.)"

Sillman (1948) had casts of 50 children from birth until 11 years. He thought that much could be done in preventive orthodontics if subtle departures from the normal could be recognized at an early age.

He found that "at birth there is no occlusion of the gum pads, and the mandibular pads are very much posterior to the maxillary pads. The mandible grows forward very quickly until with the eruption of the first deciduous molars, the relative antero-posterior relation of the jaws is definitely established, and the dental arches assume a relatively adult position.

"The horizontal overbite is thus reduced, while the vertical overbite, still pronounced, becomes less with the eruption of the molars and increased posterior alveolar growth. From $3\frac{1}{2}$–7 years there is relatively little change in the occlusion."

In 1950 Baume published his findings from the serial models of 60 children over a period of 8 years.

His conclusions were that "the deciduous models could be divided into those which had incisal spaces and those which had not. If there were no spaces when the teeth erupted, no spaces would occur between 3 and 6 years. The presence or absence of spaces is an hereditary factor—in identical twins both members are in either one or the other category.

"There were no changes in the occlusion during the period of the complete deciduous dentition; there was no mesial shift of the mandible, nor a forward adjustment of the lower teeth after the age of 4 years. When the deciduous dentition was completed at 3 years, the lower arch was already in a more forward position than the upper arch—there was a 'terminal step' in 14 per cent of cases. In the 76 per cent the upper and lower arches ended on the same vertical plane (or straight). But one pattern did not develop from the other pattern.

"When there is no terminal step but the presence of 'primate spaces' (between $\frac{dc}{cd}$) these spaces close on eruption of the first permanent molars. The lower buccal teeth thus drift forward and the first permanent molars establish normal occlusion.

"In those cases where there is no terminal step, the permanent molars erupt in a cusp/cusp relationship. This is only a temporary stage though, as the lower molars move forward more than the uppers after the change-over of the deciduous molars. This is the last adjusting mechanism of the permanent molar occlusion.

"The concept of a forward shift of the entire mandible, or the entire lower dental arch, is not borne out by facts. It is a matter purely of migration of the deciduous teeth, and the cause of migration is the pressure of eruption and root formation of the permanent molars. The 'canine axis' remains unaltered. Function and attrition have little bearing on the development of the dentition.

"With regard to the rate of lateral growth, the strongest growth impulse in the mandible is during the eruption of the permanent lateral incisors. The downward growth of the upper incisors is guided by the incisal edges of the lower incisors."

A special study of the overbite was made in 52 cases. He came to the conclusion that "no case with a severe deciduous overbite developed into a less severe permanent bite. There was a developmental tendency towards the formation of a deeper overbite (cf. Lewis). The degree of overbite depended primarily upon the amount of mandibular forward growth, which takes place at three different periods: (1) During the eruption of the deciduous canines; (2) During the eruption of the permanent incisors; (3) During the eruption of the permanent canines and premolars." [It is difficult to correlate this with his previous statement that there is no forward growth of the mandible after the age of 4 years.]

Moyers (1954) states that "Greek children living on coarse diets showed markedly altered occlusal relations between the ages of 3 and 6. This means that with primary tooth wear the normal growth of the mandibular bone may express itself in a more forward relationship to the upper face."

It can thus be seen that, though the amount of work which has been done in this field is very considerable, there is by no means complete

agreement on any of the different aspects of the development of the normal.

METHOD

The aim being to record, in a manner which would allow each stage in the transition from deciduous to permanent incisors to be reviewed comprehensively in comparison with its successors and predecessors, stone-plaster models were made from impressions of the teeth taken in zelex or parabar, as circumstances permitted.

In selecting the children, the only requirements were that the complete deciduous dentition should be present and that they should be available for inspections and impressions over a period of 5–6 years, or at least till the permanent incisors were fully erupted. (The latter requirement was the stumbling-block. Even with careful selection, there was a falling-away in the numbers.)

A number of the children were those of colleagues on the staff of the Royal Victoria Hospital, Belfast, some were private patients from town and country dental practices, others came from school clinics, and a good many were orphans from two orphanages in Belfast. The group thus has a claim to represent a good cross-section of the children of Northern Ireland.

Altogether there were 93 children; in 58 of whom there are records right through from the completed deciduous dentition to the full eruption of the permanent incisors.

Impressions were taken every six months during the period from the first shedding of a deciduous incisor to the completion of permanent incisor eruption, at other periods once yearly.

The fact that the impressions were taken more often during the active period of eruption of the incisors proved to be most valuable. Significant aspects of the eruption process would have been missed if a year had been allowed to elapse between the recordings.

Study of the changes taking place made it evident that it would have been more valuable if the occlusion at the completion of the deciduous dentition had been known. Most of the children were $4\frac{1}{2}$–$5\frac{1}{2}$ years at the beginning, only a few being 3–4 years. Miss L. M. Clinch, of London, very kindly made her series of models, 3–8 years, available. The evidence now presented is based on the study of the two series of models, which have been dealt with separately—Miss Clinch's series being studied to confirm, or otherwise, the results found on the Belfast models.

FINDINGS

Since variation in the pattern of development is the outstanding feature of my findings, I can best present them by listing the principal varieties of change, with the number of cases in which each occurred.

1. A forward relationship of the lower arch to the upper arch may be established at the completion of the deciduous dentition. Of the 21 cases of Miss Clinch's who were 3 years ± 5 months the distal borders of $\overline{E|E}$ were anterior to the distal borders of $\underline{E|E}$ in 15 cases—7 bilateral, 8 unilateral.

Of the 8 Belfast cases who were 3 years ±5 months, the distal borders of the $\overline{E|E}$ were anterior to those of $\underline{E|E}$ in 5 cases, all bilateral. (Baume found the percentage of his cases was 14.)

2. Forward movement of the lower arch relative to the upper may occur in the intact deciduous dentition.

Of the 52 cases of Miss Clinch's, the lower arch moved forward relative to the upper arch before the eruption of the first permanent molars in 13 cases—4 bilateral, 9 unilateral. (There was also forward movement in 10 cases to close spaces.)

Of 57 Belfast models there was forward movement of the lower arch at this stage in 9 cases—4 bilateral, 5 unilateral, with closure of spaces in 2 cases.

3. Forward movement of the lower arch relative to the upper may occur just prior to or during the eruption of the first permanent molars.

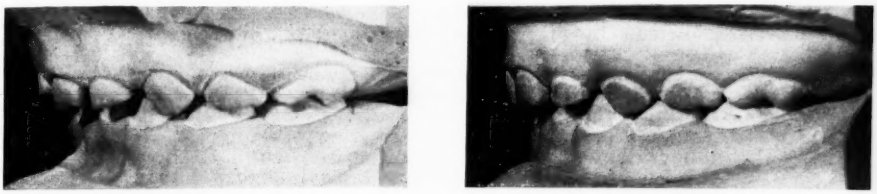
Of the 57 Belfast models there was forward movement of the lower arch at this stage in 15 cases—6 bilateral, 9 unilateral, with closure of spaces in 5 cases.

Of the 52 London models there was forward movement of the lower arch at this stage in

19 cases—5 bilateral, 14 unilateral, with closure of spaces in 11 cases.

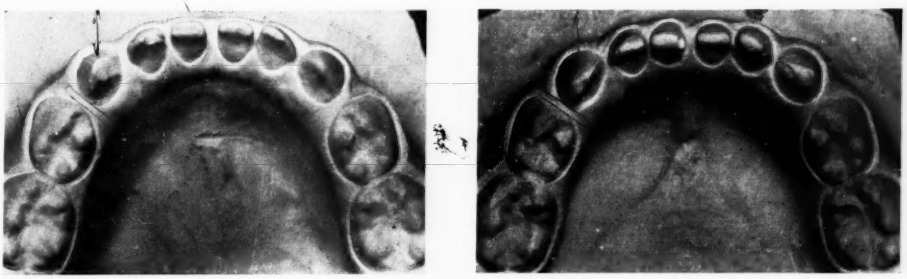
4. Forward movement of the lower arch relative to the upper may occur at the time of eruption of the lower permanent incisors.

1. Contrary to Baume's statement, it is seen that forward movement of the lower arch relative to the upper in the deciduous dentition does definitely take place, that the "canine axis" as he calls it, does change. This forward



A B

Fig. 1.—Forward movement of the lower arch relative to the upper between $3\frac{1}{2}$ and $4\frac{1}{2}$ years (A, B).



A B

Fig. 2.—Shows the lower occlusal views of A and B (*Fig.* 1). Note that though the space between $\overline{|CD}$ is reduced in B, the distance $\overline{|DE}$ have moved forward is much greater, and $\overline{|C}$ has also moved forward.

Of 48 Belfast models there was forward movement of the lower arch at this stage in 25 cases—12 bilateral, 13 unilateral.

Of 30 London models there was forward movement of the lower arch at this stage in 17 cases—7 bilateral, 10 unilateral.

5. There may be a difference in the behaviour of the buccal segments in the two sides.

In only 2 of the 57 Belfast models was there anything approaching symmetrical movement of the buccal segments on both sides.

6. No change in the arch relationship may occur up to the end of the period studied.

Of the 48 Belfast models there was no change in the arch relationship in 7 cases, and in 2 cases out of the 30 London models.

7. Changes in the arch relationship are most likely to take place in conjunction with eruption of teeth.

movement can be independent of the closure of spaces. Where there are spaces these are seen to be reduced, if not closed altogether, before or during the eruption of the first permanent molars. Often this closure of spaces is the first stage of forward movement of the lower buccal teeth, to be followed later by further movement of the whole buccal segment, or segments (*Figs.* 1, 2). *Fig.* 1 shows the left side occlusal views at $3\frac{1}{2}$ (A) and $4\frac{1}{2}$ years (B) respectively. Note the more forward relationship of $\overline{|CDE}$ to $|\overline{CDE}$ in B compared with A. *Fig.* 2 shows the lower occlusal views of A and B respectively above. It is seen that though the space $\overline{|C-D}$ is smaller in B than in A, the amount of the reduction would not, by itself, allow $\overline{|DE}$ to move as far forward. (*Table I.*)

2. *Marked forward movement of the lower arch at the time of eruption of the lower permanent*

incisors, and more especially the lower lateral incisors. This forward movement cannot be accounted for by the closure of spaces as in most of the cases where it took place there were no initial spaces to close. In some cases the forward movement of the lower arch at this stage is dramatic, being the first definite forward movement noted. In other cases however, it is less pronounced, being one of a series of stages, the lower having moved forward also at earlier periods. (*Table II.*)

It is seen occurring in cases where an upper deciduous second molar has been lost, with consequent forward drifting of the upper first permanent molar. In spite of this, the lower first permanent molar moves farther forward, and not only the molar but the whole lower buccal segment on that side.

I have been unable to find any reference to forward movement of the lower arch at this stage in the literature. In one of Broadbent's radiographs, however, the occlusion of a child of approximately 6 years is shown—then again at 8 years. In the latter, when the upper and lower incisors have erupted it is seen that the forward movement of the lower has taken place. No comments were made.

Fig. 3 shows right and left side occlusal views at 6 years, when the first permanent molars have erupted A and B) and later the right side at 8½ years (C) and the left side at 9 years (D).

At the completion of the deciduous dentition the upper left buccal segment is well forward in relation to the lower segment, but on the right side the distal surfaces of the $\frac{E|}{|E}$ end on the same vertical plane.

At 6 years (A) it is seen that $\frac{6|}{|6}$ have erupted in the cusp/cusp relationship, while $\underline{|6}$ is fully one unit anterior to $\overline{|6}$ (B).

Table I.—Showing Number of Cases where there was Forward Movement of the Lower Arch Relative to the Upper during the Deciduous Dentition

Belfast Models
(Total, 57)

	Bilateral	*Unilateral*
a. Forward movement of lower arch before eruption of $\frac{6\|6}{6\|6}$	4 (+ 1 case to close spaces)	5 (+ 1 case to close spaces)
b. Forward movement of lower arch during eruption of $\frac{6\|6}{6\|6}$	6 (+ 3 cases to close spaces)	9 (+ 2 cases to close spaces)
c. Total no. where there was forward movement of lower arch in the deciduous dentition	10 (+ 4 cases to close spaces)	14 (+ 3 cases to close spaces)

It must be pointed out that the figures in (*a*) do not show a correct proportion, as in a good many cases there was only one deciduous model before the eruption of the first permanent molars, and in some the latter were beginning to erupt.

Miss Clinch's Models
(Total, 52)

	Bilateral	*Unilateral*
a. Forward movement of lower arch before eruption of $\frac{6\|6}{6\|6}$	4 (+7 cases to close spaces)	9 (+ 3 cases to close spaces)
b. Forward movement of lower arch during eruption of $\frac{6\|6}{6\|6}$	5 (+ 8 cases to close spaces)	14 (+ 3 cases to close spaces)
c. Total no. where there was forward movement of lower arch in the deciduous dentition	9 (+ 15 cases to close spaces)	23 (+ 6 cases to close spaces)

At 8½ years (C) the lower right buccal segment has moved forward so that the mediobuccal cusp of $\underline{6}|$ is now just anterior to the buccal groove of $\overline{6}|$. The lower left buccal segment has been moving forward also, but it is not until 6 months later (D) that the mediobuccal cusp $|\underline{6}$ lies just anterior to the buccal groove $|\overline{6}$.

This case also illustrates the asymmetry of the two sides during development, yet normal occlusion is reached by both in the final models.

3. Difference in behaviour of the buccal segments on the two sides. It is seen that, even in cases where the relationship of the upper to the lower arch on both sides at the completion of the deciduous dentition is the same, and also when the permanent incisors have erupted, the ways by which the final occlusion is reached on the two sides may be very different. The buccal segments on one side may move forward at one stage, but the buccal segment (or segments) on the other side not till a later date, or perhaps not at all, e.g., often the normal molar relationship is established prior to or during the eruption of the first permanent molars on one side, while the first permanent molars on the other side erupt in the cusp/cusp relationship. When the lower incisors erupt then the latter relationship may be corrected.

Forward movement of the upper buccal segments may follow on a stage of forward movement of the lower buccal segments, even in cases where there is no sucking habit, and the lower then has to regain lost ground, before again getting to the fore. Often the lost ground is not regained and the upper arch then remains in a permanently forward relationship to the lower arch. There may be forward movement of the lower buccal segments on both sides at the same stage, but the degree of movement may vary, e.g., one side may move forward more than the other at one period, while the reverse takes place at a later period. It is the exception, rather than the rule, to

Table II.—Showing Number of Cases where there was Forward Movement of the Lower Arch Relative to the Upper during the Eruption of the Lower Permanent Incisors

Belfast Models

(Total, 58—4 were thumb-suckers and 6 had premature extractions of deciduous teeth which upset the occlusion. Therefore 48 where the occlusal changes were followed.)

	Bilateral	*Unilateral*
Number where there was forward movement of the lower arch during the eruption of the lower incisors	12	13
Therefore percentage where there was forward movement of the lower arch on one or both sides during the eruption of $\overline{21\|12}$	52·08 per cent	
Percentage where there was forward movement of the lower arch on both sides during the eruption of $\overline{21\|12}$	25 per cent	

Miss Clinch's Models

(Total, 52—22 had occlusion on both sides upset by premature extractions of deciduous teeth. Therefore the occlusal changes were followed in 30.)

	Bilateral	*Unilateral*
Number where the lower arch moved forward during the eruption of $\overline{21\|12}$	7	10
Therefore percentage where the lower arch moved forward during the eruption of $\overline{21\|12}$, on one or both sides	56·66 per cent	
Percentage where the lower arch moved forward during the eruption of $\overline{21\|12}$ on both sides	23·33 per cent	

find symmetrical movements taking place on both sides to the same extent. One cannot therefore predict what the occlusion of the permanent dentition will be until all the deciduous teeth have been replaced. (*See Fig.* 3.)

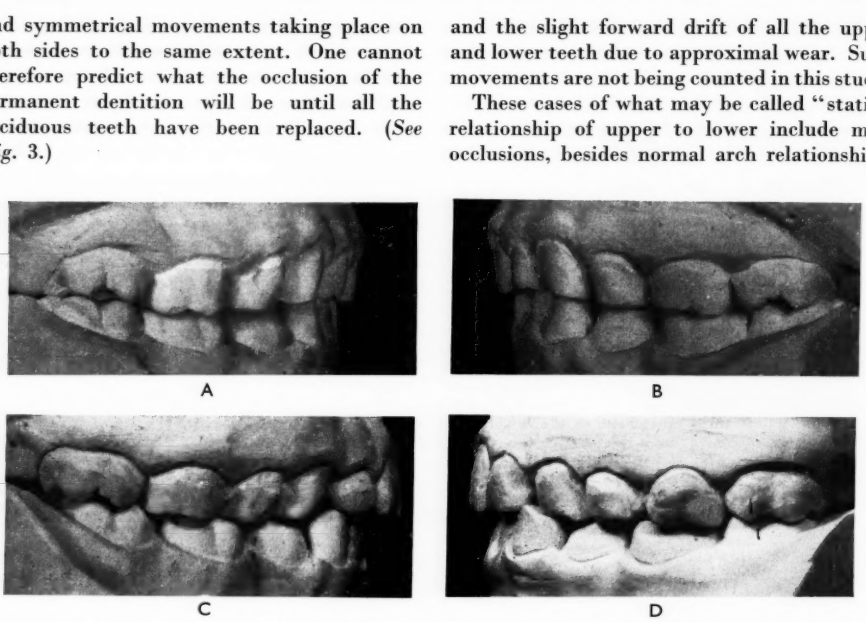


Fig. 3.—Forward movement of the lower arch during the eruption of the permanent incisors. Note difference in the original occlusal relation, A on right, B on left. The final result is the same on both sides, C and D, C being attained 6 months before D.

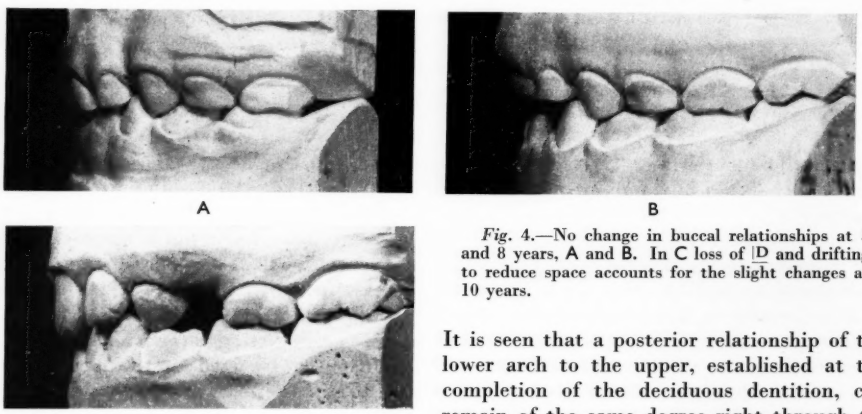


Fig. 4.—No change in buccal relationships at 5 and 8 years, A and B. In C loss of $\underline{|D}$ and drifting to reduce space accounts for the slight changes at 10 years.

4. The arch relationship, once established at the completion of the deciduous dentition, may change very little, if at all. There is, of course, always the forward drift of the first permanent molars when the premolars erupt and the slight forward drift of all the upper and lower teeth due to approximal wear. Such movements are not being counted in this study.

These cases of what may be called "static" relationship of upper to lower include malocclusions, besides normal arch relationships.

It is seen that a posterior relationship of the lower arch to the upper, established at the completion of the deciduous dentition, can remain of the same degree right through till all the permanent teeth are in occlusion (*Fig.* 4).

Fig. 4 shows the left side occlusal views of a child at 5 years (A), $8\frac{1}{2}$ years (B), and 10 years (C). In A the distal border of $\overline{|E}$ is well forward to the distal border of $\underline{|E}$. There is no change

when the first permanent molars erupt, or when the permanent incisors erupt (B). Unfortunately later there was premature extraction of $\underline{|D}$ with consequent drifting of the adjacent teeth. Had it not been for this it is likely that the relationship in C would have been the same as in B.

5. Forward movement of the lower arch takes place *principally* at the times of eruption of teeth. There are three main stages:—

a. Immediately prior to and during the eruption of the deciduous molars.

b. Immediately prior to and during the eruption of the first permanent molars.

c. Immediately prior to and during the eruption of the lower permanent incisors and especially the lower lateral incisors.

In a small number of cases it is seen that the lower arch also moves forward between the completion of the deciduous dentition and the eruption of the first permanent molars, as described by Friel and Clinch. There is also the forward movement of the permanent molars that takes place following the eruption of the premolars, though this is more of a forward drift, using up the extra space. Clinical experience also supplies evidence of a forward tendency during the eruption of the third permanent molars. But the greatest impetus to forward growth of the lower arch seems to me to coincide with the times of eruption of the deciduous second molars, the first permanent molars, and the lower permanent incisors. As evidence of (1) I am relying at the moment on the work done by Miss Clinch and Sillman and the fact that such a high proportion of the models, taken at 3 years, show that the lower arch is already in a forward relationship to the upper at the completion of the deciduous dentition. (*Table III*.)

Sillman (1948) in his records of children from birth to 11 years, found that at birth the lower gum pads were very much posterior to the upper gum pads (approximately 4 mm.). When the lower deciduous incisors erupt the lower pad came considerably forward, but with the eruption of the first deciduous molars, the dental arches assume a relatively adult relationship.

Table III.—Showing Number of Cases where the Lower Arch was already in a Forward Relationship to the Upper Arch at the Completion of the Deciduous Dentition

Miss Clinch's Models
(21 Cases—3 years ± 5 months)

	Bilateral	*Unilateral*
Distal border of $\underline{E\|E}$ posterior to distal border of $\overline{E\|E}$	7	8
Distal borders of $\frac{E\|E}{E\|E}$ on same vertical plane	3	6
Distal border of $\underline{E\|E}$ more forward than $\overline{E\|E}$	2	4

Therefore terminal step at 3 years on one or both sides in 71·43 per cent
Terminal step at 3 years on both sides in 33·33 per cent
Therefore distal borders of $\frac{E|E}{E|E}$ on same vertical plane on one or both sides in 42·85 per cent
Distal borders of $\frac{E|E}{E|E}$ on same vertical plane on both sides 14·28 per cent

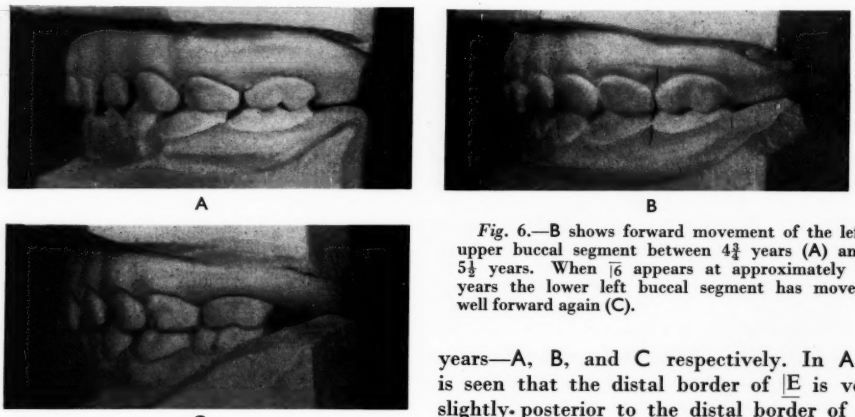
On studying the occlusion of the two cases (recorded from birth to 4 years) shown by Miss Clinch it is seen that the forward movement in one took place from $2\frac{9}{12}$–3 years, but there is no further forward movement at 4 years. In the other case there are models taken at 2, $2\frac{10}{12}$, and $3\frac{1}{2}$ years. At birth the lower gum pad is well behind the upper, but there was a vertical space in the incisor region. The lower has come forward between 2 and $2\frac{10}{12}$ years, but there is no further change between $2\frac{10}{12}$ and $3\frac{1}{2}$ years, i.e., after the eruption of the second deciduous molar.

As Sillman found that there was a great forward growth of the lower arch during the times of eruption of the lower deciduous incisors and the lower first deciduous molars,

this would complete the picture of the stages by which the lower deciduous arch moves forwards from a very much posterior relationship to the upper arch at birth, to one where the distal surfaces of the lower deciduous second molars in the lower are already forward to those of the upper at the completion of the deciduous dentition. (*Figs.* 1, 5.)

A B

Fig. 5.—Lower arch well forward to upper arch at 3 years. A, left, B, right, sides of same case.



A B C

Fig. 6.—B shows forward movement of the left upper buccal segment between $4\frac{3}{4}$ years (A) and $5\frac{1}{2}$ years. When $\overline{|6}$ appears at approximately 6 years the lower left buccal segment has moved well forward again (C).

The forward movement taking place during the eruption of the first permanent molars, is often not more than a forward drifting of the cheek teeth to close spaces, in those cases where spaces exist. Where, however, there are no spaces, a very definite forward movement of the lower arch may take place at this stage.

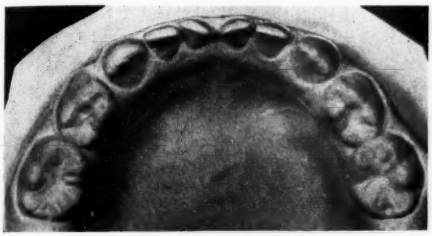
There is, alternatively, the tendency for the upper buccal segments to move forward relative to the lower at this period both in cases with and without spaces, and where there is no sucking habit to account for such movements. Forward movement of the lower arch at this stage, accompanied by an opening of the bite, was noted by Lewis and Lehmann (1926). (*Table II*, *Figs.* 6, 7.)

Fig. 6 shows the left side occlusal views of a case at $4\frac{1}{2}$ years, $5\frac{1}{2}$ years, and 6 years—A, B, and C respectively. In A it is seen that the distal border of $\overline{|E}$ is very slightly posterior to the distal border of $\overline{|E}$. In B the left upper buccal segment has moved forward so that now the distal border of $\overline{|E}$ is considerably anterior to that of $\overline{|E}$. In C $\overline{|6}$ is erupting, and it is seen that the lower buccal segment has moved well forward, so that now the distal border of $\overline{|E}$ is posterior to that of $\overline{|E}$, and $\left|\frac{6}{6}\right.$ can erupt into normal occlusion.

Fig. 7 shows the lower occlusal views of A, B, C, above. Note that the $\overline{D\text{–}C|C\text{–}D}$ spaces are reduced in B (when the left upper buccal segment has moved forward in relation to the lower), but there is no further reduction of these spaces in C, when the lower left buccal segment moved well forward in relation to the upper, on the eruption of $\overline{6|6}$.

DISCUSSION

When my findings on the changes which occur during development of the antero-posterior relationship of the arches which we regard as normal in the permanent dentition are collated with those of my predecessors in this field, it is obvious that there are discrepancies. Several possible reasons present themselves. It may be that there are in fact very wide variations in any population, and there may be great racial variations. The numbers dealt with by any observer are of course minute when considered as samples of the local population, and the geographical distribution of the groups so far recorded is wide. I find it difficult, however, to imagine that with larger samples we would find any substantial increase in the number of ways by which change of relationship can take place. The possibilities seem to be nearly exhausted in those recorded. Alternatively, it may be that certain changes which were observed by some and not by others failed to appear because of long intervals between recordings. Also it is possible that phenomena seen by some and not by others were not seen because they were not looked for. Whatever the reasons, it seems clear that it is too early to attempt any comprehensive statement as to what is the normal sequence of events leading to the establishment of normal occlusion. Professor Friel, pioneering in this field, has always emphasized that what he describes is to be regarded as the ideal occlusion, which implies that the steps recorded on the road to the adult occlusion are the ideal steps. Watching the very varied methods and timings which individual children have employed in achieving similar end-results, I find it impossible to frame a brief for any one pattern of development as "normal". As to "ideal", it would seem that to label a step in development as ideal involves a prediction. It is a statement that that step has a higher probability of leading ultimately to normal adult occlusion than has any alternative step. It is the case that on general grounds I would have predicted in some early stages that the normal would not be achieved, but I would have been wrong (*Fig.* 3). In other cases the same prediction would have been right. Clearly, very large samples would be necessary to provide a basis for a statistical prediction—if at all possible. On the present state of my knowledge I am less and less inclined to prediction. It is seen that any of the following can arise:—



A

B

C

Fig. 7.—Lower occlusal views of *Fig.* 6. Note slight reduction of $\overline{CD}$ space between A and B, but no further reduction in C, when the lower buccal segment has moved considerably forward in relation to the upper.

1. The normal relationship of the lower arch to the upper arch may be established at the completion of the deciduous dentition, negligible changes thereafter taking place. According to Sillman (1948), this position has been

reached from the very much distal relationship at birth, by a marked forward growth of the lower at the times of eruption of the lower deciduous incisors and the lower first deciduous molars. From a study of models of 2 of Clinch's cases, it is seen there is also a forward growth of the lower at the times of eruption of the second deciduous molars, but not immediately after that.

2. If the lower arch has not moved forward, as in (1), then it may do so before the first permanent molar is due to erupt. The stage is therefore set for the latter tooth, so that the tip of the medio-buccal cusp of the upper molar occludes slightly medial to the buccal groove of the lower molar.

3. Where the forward movement in (2) has not taken place, the lower teeth may move forward just prior to and during the eruption of the first permanent molars. The tip of the medio-buccal cusp of the upper tooth then, as before, occludes just medial to the buccal groove of the lower molar.

4. Where neither the forward movements of (2) or (3) have taken place, so that the first permanent molars erupt in the cusp/cusp relationship, this may be only a transitory stage. The lower arch may move forward when the lower permanent incisors erupt so that the normal relationship is established then.

5. There is the forward drifting of the upper and lower permanent molars that takes place when the premolars erupt. As the lower moves a little more than the upper, final adjustments can then take place.

6. The upper and lower buccal segments on either side move independently of each other.

SUMMARY

The normal relationship of the lower arch to the upper arch may be established:—

1. At completion of deciduous dentition.
2. Before eruption of first permanent molars.
3. During eruption of first permanent molars.
4. During eruption of lower permanent incisors.
5. The final relationship may be reached in many ways, both sides, upper and lower, moving independently to one another.

Acknowledgements.—I would like to acknowledge my indebtedness to Mr. H. T. A. McKeag for his encouragement and advice in the work from the beginning; to Mr. C. P. Adams for supervising the photography and the preparation of the slides; to Miss L. M. Clinch for making her series of models available to me; to Mr. A. G. Taylor for his assistance with the literature and references; to Miss B. Taylor for taking records during my absence; to my dental colleagues who have brought their children along regularly or referred their patients; to the Sisters in charge of Nazareth House and Nazareth Lodge without whose co-operation the work would have been very difficult; and to the Northern Ireland Hospitals Authority, under whose auspices this investigation was undertaken.

To be continued.

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BOOK REVIEW

PARTIAL DENTURES. By JOHN D. WILSON, D.D.Sc. (Syd.). $9\frac{3}{4} \times 5\frac{1}{2}$ in. Pp. 294 + xii, with 192 illustrations. 1955. London: Angus & Robertson Ltd. 70s.

THE theme of this book is how to design partial dentures so that they shall confer on the patient the maximum benefit whilst damaging to the minimum the tissues of the mouth.

The book opens with a description of the damage which may be caused to both the tissues of the mouth and more remotely those of the body by premature tooth loss, and thus established the need for the partial denture.

The author then emphasises the responsibility of the prosthetist to maintain the health of the mouth tissues and states that only by possessing an understanding of the "biological nature and physiology" of the mouth will he be capable of designing partial dentures which will not damage the tissues.

A partial denture becomes an instrument of trauma unless it is designed with full appreciation of the forces to which it will be subjected and a knowledge of how and to which tissues these forces will be transmitted by the denture. The author places emphasis on damage to the tissues by trauma and describes on the one hand the sources and types of force which are applied to the dental tissues, and on the other the means by which these tissues survive and resist the effects of applied forces. This entails a brief but careful consideration of the muscles of mastication, the temporomandibular joint, the mechanics of mastication, the reaction of the periodontal membrane to applied forces, the histology and physiology of bone, and traumatogenic occlusion.

Before a partial denture can be designed which will maintain the health of the mouth tissues a careful examination of the mouth must be made and an assessment arrived at which will include any improvement which can be made to the teeth, gingivæ, or occlusion prior to the fitting of the denture, and a thorough knowledge of the condition of the tissues which will support the denture. The manner of carrying out this examination and of assessing the findings are well discussed and described and some well-produced and pertinent X-rays enhance the text.

Occlusion is given proper prominence and well discussed. Regarding the registration of the position of occlusion the author draws attention to the fact that an increase in the vertical dimension after fitting partial dentures is frequently due to faulty chairside registration of the jaw relationships. He quotes Beckett's four types of occlusal relationships and describes methods for accurately registering the relationships for each.

The means of retention of partial dentures is well described and some good line diagrams clarify the author's ideas on this subject. He obviously met the usual difficulties of description when writing of the surveying of a model, but here again line diagrams help to make clear his points.

The chapter on the design of partial dentures is the largest in the book. The author states categorically, and rightly so, that "design and diagnosis are inseparable" and that design must therefore be undertaken by the dental surgeon and not left to the technician.

Occlusal rests, saddles, connectors, indirect retainers, and stressbreakers are well described in this chapter, always with the accent on the biological implications, and the question of the free-end saddle is fully discussed.

Up to this point the book is informative and the author has developed his important theme lucidly and interestingly and its tenets of design can be applied to any technique of denture construction, therefore one is tempted to wonder why he did not leave well alone; instead he has appended a chapter on technical procedures and attempted to describe within the confines of a few pages the construction of an acrylic resin and cast partial denture, heat treatment, repairs, curing, soldering and a whole list of technical definitions, with the result that this chapter reads rather like a cookery book. The author's justification for this, one presumes, is that he describes his own

techniques which for the construction of an acrylic partial denture consists of a wire metal framework supporting and strengthening the resin. One feels, however, that if this chapter were omitted, together with the quite uncalled-for coloured plates of a gold and acrylic partial denture as a frontispiece the cost of the book might be reduced with no sacrifice whatever to its real worth.

To sum up: this book is a valuable addition to the literature on partial denture prosthesis and can be read with profit by both students and practitioners. Old-established practitioners who were reared in the school of mechanical prosthetics will here find much food for thought and practice.

The author is to be congratulated on the large number of clear and informative line diagrams and excellent half-tone plates, and the publishers for not skimping the production.

K. P. L.

NATIONAL HEALTH SERVICE NOTES

(Service Committees and Tribunal) Regulations, 1956

THE National Health Service (Service Committees and Tribunal) Regulations, 1956, consolidate the existing Service Committees and Tribunal Regulations with a number of drafting alterations, and also make amendments of some substance incorporated after discussion with bodies representing the professions involved, and Executive Councils and their officers. The new Regulations take effect from Oct. 1.

Restriction on the Right to Make a Complaint.—Regulation 4 now restricts the right of complaint to the patient concerned, a spouse, a person with his authority, or a person acting upon behalf of a patient who is incapable or under the age of 18. Any person may make a complaint in relation to the treatment of a person who is deceased, and complaints may be made also by the Minister of Pensions and National Insurance or the Dental Estimates Board.

Time Limits on Investigation of Matters referred by the Council or by a Committee authorized by the Council.—The application of the time limits in Regulation 4 (4) to action under 4 (5) is made more precise, and in particular is applied expressly to action by the Dental Estimates Board where they are referring a matter to the Executive Council for consideration. In such a case the time from the date when the matter came to the notice of the Board—which would usually be the date of the Board's receipt of the report of the Minister's Dental Officer—to the date when they inform the Council of it, must not exceed six weeks. A similar time limit of six weeks would apply from the date of the reference to the Council to that of the decision to refer the matter to the Dental Service Committee. A time limit of six months, as in other dental cases, would apply from the completion of treatment, i.e., the signature of Part XI of form E.C.17, to the reference to the Service Committee.

Denture Conciliation Committees.—Regulation 10 follows, with some alteration of drafting, Regulation 10A which was added in 1953. It establishes the name of "Denture Conciliation Committees" for the bodies established under the provision, and brings them within the Executive Council's power of making standing orders governing the term of office of chairmen and members of Service Committees.

Appeals from Dental Estimates Board.—Regulation 18, relating to appeals against decisions of the Dental Estimates Board, has been amended so as to make clear that the function of the referees relates only to treatment as part of the General Dental Services, or to the fees payable to a practitioner for such services. The new Regulation also provides that, where the category of treatment is not in dispute, there will be no right of appeal against the Board's decision if the fee awarded by the Board is that prescribed in the Scale of Fees, or is the maximum fee.

The Regulation has also been amended to enable the appellant to produce fresh contentions at the hearing itself. This provision is, in particular, intended to meet cases in which some new aspect of the matter becomes apparent at a late stage. Normally, all facts and contentions upon which the appeal is based should, if available, be stated when notice of appeal is given.

Investigation of excessive dental treatment.—Regulation 19 contains a new provision for investigation of apparent excess of dental treatment beyond the reasonable needs of the patients concerned. The investigation is made by the Local Dental Committee on material submitted to them by the Minister relating to dental treatment not requiring the prior approval of the Dental Estimates Board.

Hospital Dental Staff: Terms and Conditions of Service

Payment of whole-time hospital dental specialists for domiciliary consultations is authorized, subject to certain conditions.

1. Agreement has been reached with the British Dental Association that subject to certain conditions whole-time dental consultants (and senior hospital dental officers in the circumstances mentioned in paragraph 4 of R.H.B. (51) 11/B.G. (51) 11) shall be paid for any domiciliary consultations they perform.

2. The Minister and the Association have agreed that in consequence the present paragraph 8 (as amended) of the Terms and Conditions of Service of Hospital Dental Staff should be deleted and the following paragraph substituted for it with effect from the date of this memorandum.

Domiciliary Consultations

(*a*) A domiciliary consultation shall, for this purpose, be limited to a visit to the patient's home, at the request of the general dental practitioner and normally in his company, to advise on the diagnosis or treatment of a patient who on medical grounds cannot attend hospital.

Visits not falling within this definition include (i) a visit made at the instance of a hospital or specialist to review the urgency of a proposed admission to hospital or to continue or supervise treatment initiated or prescribed at a hospital or clinic: and (ii) a visit undertaken as part of work done for a local health or education authority.

(*b*) Part-time officers, and (subject to sub-paragraph (*d*) below) whole-time officers, shall be paid for each consultation a fee of 4 guineas with an additional fee of 2 guineas where any operative procedure is undertaken or where the officer uses his own portable X-ray apparatus; provided however (i) that the additional fee of 2 guineas shall be payable once only in respect of each patient for the current illness and (ii) that where an officer is called for a domiciliary consultation and sees on the same occasion in the same residence or institution more than one case, the consultation fees payable shall be 4 guineas for the first case seen and 2 guineas for each subsequent case seen, with an overall maximum for consultation fees of 10 guineas however many cases are seen.

(*c*) In the case of part-time officers only, the Board shall make payments, additional to the fees set out above and to the normal travelling and subsistence expenses, of 1 guinea for a journey to a place over 20 and up to 40 road miles distant, 2 guineas for a journey to a place over 40 and up to 60 road miles distant, and so on, with an additional guinea for every 20 miles outward.

(*d*) In the case of whole-time officers only, no payment shall be made in respect of the first eight domiciliary consultations made in any quarter, except that a whole-time officer shall be eligible for the apparatus fee of 2 guineas under sub-paragraph (*b*) (i) above in respect of all domiciliary consultations at which he uses his own portable X-ray apparatus.

(*e*) The maximum remuneration under this paragraph (excluding travelling and subsistence allowances, additional mileage payment, and fees for the use of the officer's own apparatus) shall be 200 guineas in any quarter or 800 guineas in any year, whichever the officer prefers.

General Dental Services: Materials for Use for Plastic Denture Bases

Following publication by the British Standards Institution of a standard for acrylic denture base materials (B.S.2487/1954) the Minister has revised the list of approved brands. The following should be substituted for the existing list, as given in Part III of E.C.N.95:—

Acron	Minerva M.6
Art Form	Minerva F.9
Clinex 33	New Tint
Clinex Injector Cast	Oracryl
Clinex Natural Medium	Plastacryl
Kallodent 222	Portex
Kallodent 333	Stellon
Lumacryl	Supearl
Metrocryl	Thermolite

Any brand of acrylic resin previously on the approved list but not included in this list should not be used in dentures supplied on estimates started after Dec. 31, 1956.

SOCIETY NOTES

THE BRITISH SOCIETY OF PERIODONTOLOGY
Programme, 1956–7

Monday, *Oct.* 15, 1956, at 5 p.m., Eastman Dental Hospital, Gray's Inn Road, W.C.1: Annual General Meeting; Presidential Address by Professor M. A. Rushton, "Idiopathic and Hereditary Hyperplasia of the Gingivæ".

Monday, *Nov.* 19, 1956, at 5 p.m., Eastman Dental Hospital: "A Symposium on Instruments" by W. G. Cross, M.S., M.B., B.D.S., R.D. Emslie, M.S.(Ill.), B.D.S., F.D.S. R.C.S., and A. B. Wade, B.Ch.D., F.D.S. R.C.S.

Monday, *Jan.* 21, 1957, at 5 p.m., Eastman Dental Hospital: Casual Communications by Associate Members.

Monday, *Feb.* 18, 1957, at 5 p.m., Eastman Dental Hospital: "An Investigation into the Glycogen Content of the Gingivæ" by J. R. Trott, B.D.S.

Monday, *March* 18, 1957, at 5 p.m., Eastman Dental Hospital: "The Value of Mastication" by J. H. Farrell, M.D.S.

Friday, *April* 5, 1957, at 2 p.m., Eastman Dental Hospital: Annual Clinical Meeting. Dinner-Dance at the Criterion Restaurant.

Saturday, *May* 4, 1957, University of Leeds Dental Hospital and School, Blundell Street, Leeds, 1: "Fundamentals of Collagen" by Professor W. T. Astbury; "Periodontal Tissues in the Cat, the Rat, and the Rabbit" by R. T. Heylings, M.B., Ch.B., B.Ch.D.

FEDERATION DENTAIRE INTERNATIONALE

News Letter No. 16 (September, 1956) contains: An In Memoriam notice—Dr. Juan Ubaldo Carrea of Argentina; "Why the Fédération Dentaire Internationale?"—by Dr. O. H. Moen, U.S.A.; Notes on the XII International Dental Congress; A Chronicle of the XLIV Annual Meeting of the F.D.I., Zürich, Switzerland; as well as information under the headings—Treasury; F.D.I. Representation at Meetings: (a) Reports Received, (b) Representatives appointed; World Health Organization; News from Member Countries; Publications Received; Dental Meetings.

INTERNATIONAL DENTAL EXHIBITION, MUNICH

THE International Dental Exhibition, of which the thirteenth in the series took place in Munich this year, occupied an area of 6700 sq. metres. Of the 362 firms who took part, 84 were from outside Germany.

Since the last exhibition, held in Düsseldorf in 1953, considerable attention has been directed to the subject of pain-free treatment, to which extra-high-speed drills, diamond sharpening devices, and improved local anæsthetics have contributed. The exhibition was fully representative of these advances and indeed gave a comprehensive view of progress in dental technique and equipment of all kinds.

The Congress of the united German dental profession, which was held at the same time, directed its attention to the problems of the possibility of sterile treatment, the maintenance of dental health, and prosthesis for well-fitting and functional dentures, in each of which fields the supply houses are alert to supply the requirements of the profession.

EUROPEAN ORGANIZATION FOR RESEARCH INTO FLUORIDES AND CARIES PROPHYLAXIS

Third Administrative Session, Marburg/Lahn, June, 1956

After formal business, Prof. Minoguchi, of Kyoto, and Dr. Fleming, of New Haven, U.S.A., were unanimously nominated as corresponding members in recognition of their constructive collaboration.

The representative of working party No. 1, Prof. Baume, Switzerland, placed before the full committee the final draft concerning the standardization of statistical methods in connexion with caries which was given a final discussion, from which emerged the basis of the standard caries tests of ORCA. The very lively discussion brought out a number of important points of view, particularly in connexion with terminology. Having brought this first task to a successful conclusion, working party No. 1 will undertake the task of devising statistical methods both for the control of mass-prophylactic steps and for social hygiene purposes. The General Secretary, Dr. Schmidt, presented the suggestion of working party No. 2 concerning the relationship between the necessary additional fluoride intake and the daily food intake when fluorine is added. Dr. Quentin, the representative of working party No. 3, explained a first suggestion for water examination with regard to mineral content in general and fluorine content in particular, containing directions for the basic analysis and control conditions concerning fluorine content for the supervision of fluoridization.

DEMONSTRATIONS

CLAUDIUS ASH SONS & CO. LIMITED invite dentists to visit their London Showrooms, 26–40, Broadwick Street, W.1, on Tuesday, Oct. 16 to Friday, Oct. 19 inclusive, 6.30 p.m. to 10 p.m., to inspect a special display of the latest additions to the STERLING range of equipment.

Technical demonstrations: The modern scientific approach to filling materials; Surgery planning; Practical examples of the manufacture of long handle instruments, hardening and testing of burs.

Film programme. Refreshments.

EXAMINATION RESULTS

UNIVERSITY OF DURHAM

September, 1956

Degree of Bachelor of Dental Surgery (*First Examination*):—
Peacock, R.; Tong, R. C. Y.

Licence in Dental Surgery (*First Examination*):—
Bayley, B. J.; Gale, P. W.; Spence, P.; Weisert, A. H. R.

Degree of Bachelor of Dental Surgery (*Second Examination*):—
Thomas, J. F. G.

Licence in Dental Surgery (*Second Examination*):—
Drinkwater, J. M.; Gregory, A. T.; Jackson, W.; Oosthuysen, J. J.; Phillips, W. H.; Riley, H.; Sheff, A. F.; Stimson, N. J.

Degree of Bachelor of Dental Surgery (*Fourth Examination*):—
Abbott, E.; Abrahams, M.; Adair, B.; Cowell, T. A.; Madhoo, P.; Matthews, C. S.

Licence in Dental Surgery (*Fourth Examination*):—
Annis, M. R.; Forster, P. E.; Selby, G. K.; Sowter, P. J.